

baseline. Because combined stimulation altered the activation patterns in each of these regions in ways that the single stimuli did not, they were labelled our regions of interest. Given the role they each play in dlPFC and vestibular pathways, the inhibitory function exerted by the dlPFC on vestibular processing likely centres around one or more of these areas.

Research Category and Technology and Methods

Clinical Research: 18. Functional Brain Imaging

Keywords

dlPFC, fMRI, tACS, Vestibular System

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P3.028

INCONSISTENT TMS DOSING IN NON-MOTOR AREAS AS A KEY FACTOR IN INTERINDIVIDUAL VARIABILITY OF TMS/EEG RESPONSES

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Abstract

The field of transcranial magnetic stimulation (TMS) is trending toward increased individualization to improve efficacy and reproducibility in both research and clinical practice. In non-motor regions, one factor driving variability may be the use of motor threshold to set the stimulation intensity.

In this retrospective study, we aimed to assess the impact of e-field strength on TMS/EEG for the inferior parietal lobule (IPL). We performed e-field simulations on individual brain models to estimate e-field strength when TMS was applied at 120% of resting motor threshold (rMT) in 35 older adults (age=71.79±5.9 years, 55.8%female). We also computed TMS-evoked responses at the scalp level as local mean field potentials (LMFP) and at the source level as normalized current densities directly beneath the TMS coil.

Our results revealed that, at the group level, e-field strength was significantly lower in the IPL compared to the M1 region at 120%rMT ($t(1,34)=5.49$, $p<0.001$). Analyses of individual data showed that while most participants were under-dosed (i.e., IPL e-field strength >10% below M1), a few were over-dosed. More importantly, we found positive correlations between e-field strength and local TMS-evoked responses at the source level across multiple early time windows (35–55ms, Spearman's $\rho=0.465$, $p<0.01$). In most time windows, correlations between rMT and e-field strength were lower than those at the source level (35–55ms, Spearman's $\rho=0.299$, $p=0.08$). Notably, we found that e-field strength correlated more robustly with source-level activity than with LMFP (35–55ms, Spearman's $\rho=0.246$, $p=0.07$), suggesting a specific effect of the e-field at the source level.

These findings suggest that dosing based on %rMT obtained from the motor cortex leads to inconsistent stimulation intensities in non-motor areas, potentially contributing to inter-individual variability in TMS-evoked responses. Our results support the use of e-field-based dosing to ensure more effective and standardized cortical stimulation in non-motor regions.

Research Category and Technology and Methods

Basic Research: 10. Transcranial Magnetic Stimulation (TMS)

Keywords

TMS, EEG, E-field modeling

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P3.029

IMPACT OF THETA BURST STIMULATION ON FACE PROCESSING IN AUTISM: INTERIM RESULTS FROM A RANDOMISED CONTROLLED TRIAL

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Abstract

Background: Challenges with face processing are well documented in autism, a condition for which there are no biomedical therapies that target social difficulties. Face processing has been linked to the right temporoparietal junction (rTPJ), and there is both neuroimaging and neurophysiological evidence of atypical rTPJ function in autism. The current study aimed to investigate whether intermittent theta burst stimulation (iTBS) administered to the rTPJ can improve performance on neuropsychological measures of face processing in autism.

Methods: Here we report the interim results from an ongoing randomised controlled trial. Participants ($n = 66$) diagnosed with autism spectrum disorder (aged 14–40 years, $M = 21.32$, $SD = 7.03$; 38 male, 28 female) received four weeks of either active or sham iTBS (600 pulses at 70% resting motor threshold) to the rTPJ (20 sessions), targeted via MRI(T1)-guided neuronavigation. Assessments of face processing (Reading the Mind in the Eyes Test [RMET], Benton Facial Recognition Test [BFRT], and Cambridge Face Memory Test [CFMT]) were conducted before, after, and one month following iTBS. Data were analysed using mixed model analysis of variance.

Results: There was an interaction effect (time x condition) for the BFRT, $F(2, 128) = 5.32$, $p = .006$, $\eta_p^2 = .08$. Follow-up analyses revealed stronger performance in active compared to sham at one-month post iTBS ($p = .016$). There were no interaction effects for the CFMT or RMET. Further analysis, however, revealed significant differences at one-month iTBS on the RMET, $t(61) = 2.11$, $p = .039$, Cohen's $d = 0.53$, with participants who received active stimulation ($M = .73$, $SD = .15$) more accurate than participants who received sham ($M = .65$, $SD = .16$).

Conclusions: These findings suggest that iTBS applied to the rTPJ can improve face processing, which could have clinical implications for biomedical therapeutics in autism.

Research Category and Technology and Methods

Clinical Research: 10. Transcranial Magnetic Stimulation (TMS)

Keywords

autism spectrum disorder, face processing, theta burst stimulation, randomised controlled trial

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P3.030

FREQUENCY-DEPENDENT DEEP BRAIN STIMULATION OF THE LATERAL HYPOTHALAMIC AREA MODULATES AROUSAL LEVEL AND CORE BODY TEMPERATURE IN HEALTHY AND PARKINSONIAN MONKEY

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Abstract

Background: Deep brain stimulation (DBS) has emerged as a promising therapeutic avenue for alleviating motor symptoms in Parkinson's disease (PD). However, non-motor symptoms, such as daytime sleepiness, continue to pose significant challenges in PD management, warranting further investigation. The lateral hypothalamic area (LHA), known for its crucial role in arousal regulation, presents a compelling target for addressing sleep/wake disturbances in PD.

Objective/hypothesis: In this pilot study, we aimed to explore the potential of frequency-dependent DBS within the LHA to modulate arousal levels and core body temperature in a primate model of PD. We hypothesized that high-frequency stimulation would reduce arousal levels and core body temperature, while low-frequency stimulation would enhance arousal and normalize core body temperature, particularly in the context of Parkinsonian pathology.

Methods: We conducted experiments on healthy nonhuman primates, subsequently rendered Parkinsonian through the administration of MPTP. A modified multiple sleep latency test was employed to assess sleepiness levels during both healthy and Parkinsonian states. DBS at varying frequencies was applied within the LHA, and its effects on sleepiness and core body temperature were evaluated.

Results: Our findings demonstrate a frequency-dependent modulation of wakefulness and core body temperature by LHA-DBS. Specifically, high-frequency stimulation elicited a reduction in arousal levels and core body temperature in healthy states, whereas low-frequency stimulation led to increased arousal levels and normalized core body temperature in Parkinsonian conditions characterized by daytime sleepiness.

Conclusion: The present study highlights the potential of frequency-dependent DBS within the LHA as a novel therapeutic approach for addressing non-motor symptoms, such as daytime sleepiness, in PD. Our findings offer valuable insights into the intricate mechanisms underlying arousal regulation and suggest promising avenues for future research aimed at refining DBS interventions for improved PD management.

Research Category and Technology and Methods

Translational Research: 1. Deep Brain Stimulation (DBS)

Keywords

Parkinson's disease, Lateral hypothalamic area, Deep brain stimulation, Excessive daytime sleepiness

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P3.031**SUBTHALAMIC LOCAL FIELD POTENTIAL DYNAMICS DURING MOTOR CORTEX AND BASAL GANGLIA TRANSCRANIAL ULTRASOUND STIMULATION**

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Abstract

Low-intensity transcranial ultrasound stimulation (TUS) is a promising non-invasive neuromodulation method. Despite significant advancements in understanding the effects of TUS on cortical areas in animal models and healthy individuals, its impact on deep brain structures, especially in patient populations, remains largely unexplored. Herein, we examined the effects of TUS on the globus pallidus interna (GPi) and motor cortex (M1) in Parkinson's disease (PD) patients by recording local field potentials (LFPs) directly from the subthalamic nucleus (STN).

Seventeen PD patients with bilateral STN Percept PC deep brain stimulation (DBS) systems participated in this sham-controlled study. We applied theta burst (5Hz) TUS (tbTUS) for 2 minutes to each hemisphere targeting M1, GPi, and occipital cortex in separate sessions. LFPs were recorded simultaneously before, during, and at 10, 30, and 45 minutes after the sonications. During the sham condition, the procedure was performed with the stimulation intensity set to 0 watts.

Patients reported no adverse events related to TUS. Compared to the sham condition, M1-tbTUS significantly increased theta power and suppressed beta power, whereas GPi-tbTUS increased beta power. These effects persisted for at least 45 minutes. In contrast, occipital cortex-tbTUS (active

sham) did not differ significantly from the passive sham condition. Movement (finger tapping task) significantly amplified the effects of M1-tbTUS on the alpha band.

These results provide direct evidence of target engagement and specificity of TUS in cortical and deep brain structures in humans and offer promising insights into its potential as a safe, non-invasive brain stimulation technology for treating neurological disorders.

Research Category and Technology and Methods

Translational Research: 6. Pulsed Ultrasound (pUS)

Keywords

focused ultrasound neuromodulation, local field potentials, Parkinson's Disease, deep brain stimulation

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P3.032**EXCESSIVE PALLIDAL BETA-BAND ACTIVITY & FUNCTIONAL CONNECTIVITY: A NOVEL INTRACRANIAL BIOMARKER OF STATUS DYSTONICUS**

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Abstract

Objective:

Characterize novel neural correlates of status dystonicus (SD) and assess their relation to clinical severity.

Background:

SD is an emergency with severe episodes of dystonia, necessitating urgent hospital admission. Deep brain stimulation (DBS) of the globus pallidus interna (GPi) is a treatment for refractory SD. Intracranial neural correlates to SD-states and corresponding clinical severity are unknown.

Methods:

Nine patients with SD (Hospital for Sick Children, Canada) were implanted with sensing-capable Medtronic Percept™ GPi DBS (age: 7.8±3.6). Local Field Potentials (LFPs) were recorded at multiple time points during SD and after recovery in non-SD states longitudinally (6-36 months; range: 11-1155 days; average: 319±358 days) and Power Spectral Densities (PSDs) calculated (Welch-method). Analysis of PSD periodic and aperiodic components was performed using fitting-oscillations/one-over-f methods. Band-limited power (Theta: 3-7Hz; Alpha: 7-12.5Hz, Beta: 12.5-30Hz, Gamma: 30-60Hz) was calculated. Intra-pallidal functional connectivity in SD and non-SD was computed using magnitude squared coherence (MSC) between outer (contact 3-referenced-to-2) and inner (1-to-0) GPi. Mixed effects models (MEMs) assessed relations between LFP metrics and clinical scales, including Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS) and Pediatric Quality of Life Score (PedsQL).

Results:

Across all patient recordings at optimal contact points, the peak power of the periodic component of the LFP in the beta-band ($p=0.01$) and band-limited beta-band power ($p<0.001$) increased in SD compared to non-SD. GPi beta-band MSC ($p<0.001$) increased in SD (0.24 ± 0.10) from non-SD (0.16 ± 0.08). MEMs controlling for random effects of patient and time determined significant correlation ($R^2=0.80$) between decreased PedsQL and increased beta power ($p=0.004$; intercept $p=0.007$). Results were beta-band specific with no significant associations with theta ($p=0.793$) or alpha-band power ($p=0.877$). Similar results were seen for PedsQL motor-subscores but not BFMDRS.

Conclusions:

Excessive pallidal beta-band activity and functional connectivity are newly described biomarkers of SD, correlating with clinical severity.